Remarks

New claims 63-65 have been added. Claims 30, 32-37, 46-53, and 55 to 65 are pending in the application. Examination and consideration of the claims is requested. Allowance of the claims at an early date is respectfully solicited.

New claim 63 has been added to claim the plastic pallet of the invention wherein the composition is further defined in accordance with the amounts already present in pending claim 49.

New claim 64 has been added to claim the plastic pallet of the invention further comprising friction material laminated adhesion-free to at least one surface of the pallet. Antecedent basis for this new claim is to be found in the specification, for example, on page 18, line 32 to page 19, line 3.

New claim 65 has been added to claim the plastic pallet of the invention further comprising friction material in-mold applied to the surface of at least one molded member of the pallet. Antecedent bases for this claim is to be found in the specification, for example, on page 15, line 3, and on page 15, lines 24-29.

REPEATED REJECTIONS

Claim Rejections – 35 USC 103

The 35 U.S.C. 103 rejections of claims 30, 32-37, 46-53, and 55-62 have been responded to in detail in Applicant's Response under Rule 1.111 (Amdt. F). Pages 7 – 20 of Amdt. F are hereby incorporated herein by reference.

RESPONSE TO PARAGRAPHS 5 – 10 IN THE FINAL REJECTION

Paragraphs 5 through 10:

The Office Action is replete with inaccurate quotations, quotations out of context, failure to appreciate punctuation, and outright mischaracterization of the primary reference. Applicant's

attempts to use dictionary definitions and technical publications (in accordance with their use by those skilled in the art of polymer chemistry and product development) to clarify words and concepts at issue in rejections have been denigrated or ignored in the Office Action. Applicant will again attempt to clarify the issues and the record and will supply passages from technical publications well-accepted in the field of chemistry to support the accuracy of his arguments.

Paragraph 5.

On page 3, line 3, of the Office Action, it is alleged Oishi et al (col. 69, lines 1-3) teaches a "part or component of transportation equipment or container". In actuality, the quote begins on col. 68, line 64, to col. 69, line 5, and the relevant portion says:

> "The thermosetting molding composition is useful as a general molding material or the like and its application can be expanded to a wide variety of fields such as household appliances, parts and components of transportation equipments such as automobiles, industrial parts and components, tanks, containers, apparatuses, and electrical parts and components such as electrical insulating materials and electronic substances."

As written, Oishi et al is not linking "transportation equipments such as automobiles" with "containers". The Office Action fails to appreciate that Oishi et al is disclosing a **variety of fields** that are listed, each being separated from the others by commas. A misquote and failure to appreciate the use of punctuation and the scope of the teaching have resulted in mischaracterization of the reference.

It is further to be appreciated that cols. 68-69 are part of Oishi et al. third invention group which relates to thermosetting compositions only.

The Office Action alleges on page 3, second full paragraph:

> "A blend of one or more polyolefin resins and one or more thermosetting resins is explicitly taught at col. 29, lines 1-6 of Oishi et al. Rubbers are thermosetting resins".

Applicant finds **no such explicit teaching** to the alleged blend of polyolefin and thermosetting resins. Polyolefins are not mentioned in this passage at col. 29, lines 1-6 of Oishi

et al. Rather, Applicant finds an ambiguous statement relating to blends that are **further defined to refer to blends within four categories** as set forth at col. 29, lines 7-67 of Oishi et al. The **four categories are : thermoplastic resins (lines 8-56, which includes blends, block copolymers, graft copolymers and rubber-modified polymers of these resins); thermosetting resins (lines 56-64 which include blends thereof and resins obtained by modifying these resins with rubber or the like); rubbers (lines 64-65); and blends and modified resins of these resins with oils (lines 65-67).** Applicant finds no teaching in Oishi et al. that "Rubbers are thermosetting resins." What Oishi et al. does teach is that rubbers can be used to modify polymers. A rubber-modified thermoplastic resin is classified as a thermoplastic resin (see col. 29, up to semicolon on line 55, which falls within the section dealing with thermoplastic resins). A rubber-modified thermosetting resin is classified with thermosetting resins (see col. 29, lines 55(last word) until line 64, middle of the line). A rubber-modified resin, as stated by Oishi et al. is a **modified resin, not a blend of resins**. Again, the Office Action has mischaracterized the reference. Although Applicant has been criticized in the Office Action for defining words using a dictionary (see page 5, paragraph 6 of the Office Action), dictionaries and technical publications are often used in the patent arts to clarify meanings of words under consideration. HANDBOOK OF PLASTIC MATERIALS AND TECHNOLOGY, edited by Irvin I. Rubin, John Wiley & Sons, Inc. New York (1990) pp. 1192-1193, and PLASTICS MATERIALS AND PROCESSES, Charles A. Harper and Edward M. Petrie, Wiley-Inerscience, Hoboken, New Jersey (2003) pp.152-154 are enclosed and marked. These technical references say that **rubbers may be either thermosetting or thermoplastic** and these references are enclosed and the specific passages are marked. Two technical references having different dates are enclosed to show the state of the art when this application was filed and the present state of the art are the same. **Rubbers may be either thermosetting or thermoplastic.** Oishi et al. teaches modifying a thermoplastic resin with a rubber moiety to give a rubber-modified thermoplastic resin; Oishi et al. teaches modifying a thermosetting resin with a rubber moiety to give a rubber-modified thermosetting resin. Oishi et al. shows that a rubber-modified resin can be either thermoplastic or thermosetting. Oishi et al. **does not explicity teach** blending polyolefin and thermosetting resins, or even thermoplastic and thermosetting resins.

The third full paragraph on page 3 of the Office Action alleges that Oishi et al. does indeed suggest a pallet, and the supporting quotation is stated as:

> "part or component of transportation equipment" (col. 69, lines 1-2).

As previously noted, the relevant portion of the quotation in the reference within commas is:

> "parts and components of transportation equipments such as automobiles".

Again, using an abbreviated portion of the quotation has resulted in a mischaracterization of the reference in the Office Action. Applicant sees no suggestion to a pallet here. This matter also arises on page 4, third full paragraph, of the Office Action.

The final paragraph on page 3 of the Office Action refers to col. 29 of Oishi et al., lines 55-56, where it says:

> "blends, block copolymers, graft copolymers, and rubber-modified polymers of these resins"

This is alleged to disclose blends of thermoplastic and thermoset polymers. "Rubber-modified polymers" does **not represent a blend**. As stated, it represents modified polymers. As noted above, four separate classes are set forth by Oishi et al. at col. 29, lines 7 – 67. These are thermoplastic resins (lines 8-56); thermosetting resins lines 56-64; rubbers (lines 64-65); and blends and modified resins of these resins with oils such as lubricating oils, silicone oils, metal working oils, and polypropylene wax. There is no teaching to combinations of polyolefin resins and thermosetting resins, or even to thermoplastic and thermosetting resins. The Office Action alleges, referring to Oishi et al. col. 29, lines 55-56 :

> " this portion is a repetition of what is stated at col. 29, lines 1-6."

This portion is definitely not a "repetition" of what is stated at col. 29, lines 1-6. Lines 55-56 are part of an expansion and clarification (actually some 60 lines in length) of lines 1-6. Lines 55-56 (up to the semicolon on line 56) relate only to thermoplastic resins. Again, the reference has been mischaracterized.

The Office Action, as previously noted, rejects teachings from dictionaries and technical publications. On page 4, first full paragraph of the Office Action, again a partial quote is used to mischaracterize a statement – in this case Applicant's. In discussing interpenetrating polymer

networks, Applicant's Response says: "These are not merely blends, they are true networks, one polymer having been crosslinked in the presence of the other polymers." Applicant says further: "This is not a "blend" which is a mix or mingling of polymers". A reference, previously made of record, is cited again. L. H. Sperling, "Introduction to Physical Polymer Science," John Wiley & Sons, New York (1986) pages 46-47, which is of record. The Examiner is respectfully encouraged to study the diagrams and short written explanations of networks and blends. They are different and those skilled in the art have recognized them as distinct. Here, failure to see value in a technical publication written by experts in the field, coupled with a quotation out of context, causes the Examiner to not understand the present invention and how it is differentiated from references cited.

As to third full paragraph on page 4 of the Office Action, Applicant has previously noted that Oishi et al. **Invention Group 3, relates only to thermosetting resins.** Here the utility "container" is listed. Applicant has noted above the reliance by the Examiner on a misquotation , i.e.;

"part or component of transportation equipment (col. 69, lines 1-3)"

represents only a portion of a passage, taken out of context, from the reference, rather then the thought between commas, i.e.: "part or component of transporation equipment such as automobiles". "Container" is a utility for an article produced from a thermosetting resin. This has been discussed in detail above. Again, the reference has been mischaracterized.

On page 5, the Office Action says that Oishi et al. teach the composition of claims 49 and 50 except for the relative amount. Clearly, this statement suggests that Claims 49 and 50 are distinguished from Oishi et al. and thus patentable over this reference.

Paragraph 6:

It is accepted in the patent arts that a word or term used in a patent application or reference is to be given its common and usual meaning unless otherwise defined in the application or reference. The Examiner rejects Applicant's use of a Dictionary definition for the word "structural" which has not been defined in the reference or in the present application. Applicant is not **applying** a blend of thermoplastic/thermoset resins to a structure (i.e., as a coating) as in the Perez et al.

reference. Rather, in the instant invention, the thermoplastic/thermoset resin combination **is the structure**. The Examiner again fails to appreciate what a **structural** component is and rejects a Dictionary definition provided by Applicant.

Paragraph 7:

Applicant has addressed the rejection of claim 46 in his previous Response.

Paragraph 8:

Applicant agrees that arguments regarding 35 USC 103 rejections first and foremost relate to the primary reference, Oishi et al.. A fair reading of Oishi et al. **does not teach or suggest a flame-retardant polyolefin/thermoset blend useful as a transportation container**. No "part or component of transportation equipment" that is a "container" is mentioned in Oishi et al. nor is a polyolefin/thermoset blend (or even a thermoplastic/thermoset blend) explicitly mentioned anywhere. The correct partial quotation is:

"parts or components of transportation equipments such as automobiles" .

Again, a quotation must not be taken out of context such that the result is a distortion and outright mischaracterization of the reference.

Paragraph 9:

Applicant does not enjoy nit-picking words, but the Examiner's expression: "The pallet of Oishi et al. and Endo et al." cannot remain uncorrected. **There is no pallet mentioned in Oishi et al.** and the record must be clear on this point. A pallet is mentioned in Endo et al. but the resin composition in Endo et al. is not at all similar to that of the present invention. In Perez et al. the composition is **applied** to a storage vessel (i.e., as a coating). It is to be appreciated that a storage vessel can be a box, a plastic bag, a cup, etc. It is submitted that a plastic coating of a coated storage vessel, wherein the coating clearly is not structural, does not suggest Applicant's plastic pallet.

Oishi et al does not teach a container as a part or component of transportation equipment. This, as noted above, represents a mischaracterization of the reference. Oishi et al. quotation says:

"parts or components of transportation equipments such as automobiles".

A closer reading of the reference gives a different meaning to the passage and does not teach or suggest a pallet.

Paragraph 10:

As to the bridging paragraph of pages 6-7 of the Office Action, Applicant repeats his arguments relating to use, in the Office Action, of a partial quotation (i.e., "part or component of transportation equipment") rather than a partial but correct quotation (i.e., "parts or components of transportation equipments such as automobiles") on col. 69, lines 1-3 of Oishi et al. to mischaracterize the reference. Also, Applicant fails to find explicit teaching to a "blend of polyolefin and thermosetting resins" in col. 29, lines 1-6 of Oishi et al. Rather, this passage in Oishi et al. represents an ambiguous statement that is clarified in the long paragraph in col. 29, lines 7-67 of the reference. This has been discussed in detail above and shows that Oishi et al. means blends of more than one thermoplastic resin **or** blends of one or more thermosetting resins, but does not teach blends of the two types of resins. Further, there is no teaching or suggestion to a combination of polyolefin and thermosetting resins as is disclosed in the present invention.

As to "antifouling" on page 7, first full paragraph, again it is well-accepted in the patent arts to use a Dictionary definition where a word or phrase needs defining. Such a definition is useful where no definition is given in a reference. **This is not irrelevant.** Anti-fouling has a specific meaning in the English language and in the patent arts and its meaning can be found in a Dictionary and relied upon. Applicant notes that unlike the hull of a ship below the water line, a plastic pallet is not an underwater structure subject to attack by barnacles, and an antifouling compound is not indicated.

As to Applicant's alleged piecemeal analysis, the Oishi et al. reference, being the primary reference, has been discussed in great detail. In the instant case, it is submitted that the

secondary references do not overcome the shortcomings of the primary reference, and hence the rejections fail.

CONCLUSION

Applicant has shown the Office Action is replete with inaccurate quotations, quotations out of context, failure to appreciate punctuation, and outright mischaracterization of a reference. Applicant has shown his attempts to use dictionary definitions and passages from technical publications (in accordance with their use by those skilled in the art of polymer chemistry and product development) to clarify words and concepts at issue in rejections have been denigrated or ignored in the Office Action. Applicant has again attempted to clarify the record and has supplied passages from technical publications well-accepted in the field of chemistry to support the accuracy of his arguments.

It is submitted that all objections and rejections have been overcome. Examination and reconsideration of the application as amended are respectfully requested. Allowance of claims 30, 32-37, 46-53, and 55 to 65 at an early date is solicited.

Respectfully submitted,

September 1, 2005
Date

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PLASTICS MATERIALS AND PROCESSES

A Concise Encyclopedia

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CONTENTS

eight-harness satin weave
See weave.

ejector assembly mold hardware The *ejector pin* (or *sleeve*) is a pin or thin plate that is driven into a mold cavity from the rear as the mold opens, forcing out the finished piece. This is also known as a *knockout pin*. The *ejector plate* is a plate that backs up the ejector pins and holds the *ejector assembly* together. The *ejector return pins* are projections that push the ejector assembly back as the mold closes. These are also called *surface pins* and *return pins*. The *ejector rod* is a bar that actuates the ejector assembly when the mold is opened.

Ejector pads are plates that, in essence, are used as knockout pins. They form part of the molding surface, which eject cold molded products from a mold, the material being too soft to withstand small area knockout pins. Such steel pads may cover the entire bottom surface of the mold or form substantial areas of the molded piece.

elastic deformation The elastic deformation is that part of the deformation of an object under load that is immediately recoverable when the load is removed. *Elastic recovery* is the fraction of a given deformation that behaves elastically. A perfectly elastic material has an elastic recovery of 1; a perfectly plastic material has an elastic recovery of 0.

elasticity Elasticity is that property of a material by virtue of which it tends to recover its original size and shape after deformation. If the strain is proportional to the applied stress, the material is said to exhibit *Hookean* or *ideal elasticity*. Sometimes materials with this property are also said to be *viscoelastic materials*.

See modulus of elasticity; Hook's Law.

elastic limit The elastic limit is the extent to which a material can be stretched or deformed before taking on a permanent set. *Permanent set* occurs when a material that has been stressed does not recover its original dimension, as when a 12-in. piece of rubber that has been stretched becomes 13-in. long when relaxed.

elastic memory Elastic memory or *plastic memory* is the phenomenon by which cast plastic sheets that are heated above a certain temperature (generally the *heat distortion temperature*) have a strong tendency to revert to their original flat shape. Thus a flat sheet that has been thermoformed to a new shape reverts to a flat sheet if sufficiently heated.

Although this limits the maximum service temperature of a material, it allows the fabricator to reheat and reform a sheet without loss if he happens to make a mistake in shaping it. Molded parts exhibit the same tendency. In attempting to relieve the strains incurred in molding, they tend to distort. As in sheet fabrication, this also limits the top service temperature in a molding.

elastomer ASTM defines an elastomer as a macromolecular material that returns rapidly to approximately its initial dimensions and shape after substantial

deformation by weak stress and release of the stress. Elastomers (or *rubbers*) are an important group of polymers that may be either thermosetting or thermoplastic. This group of materials includes thermoplastic elastomers, melt-processable rubbers, thermoplastic vulcanizate, synthetic rubbers (e.g., butyl, neoprene, nitrile, and silicone rubbers), and natural rubber.

An elastomer is a material that at room temperature stretches under low stress to at least several times in length and snaps back to the original length on release of stress. The properties of typical elastomers are defined by the following requirements:

a. They must stretch rapidly and considerably under tension, reaching high elongations (200–1000%) with low damping (i.e., little loss of energy as heat).
b. They must exhibit high tensile strength and high modulus (spiffiness) when fully stretched..
c. They must retract rapidly, exhibiting a phenomenon of snap or rebound.
d. They must recover their original dimension fully on the release of stress, exhibiting the phenomena of resilience and low permanent set.

The molecular requirements of elastomers may be summarized as follows:

a. The material must be a high polymer.
b. It must be above its glass transition temperature (T_g) to obtain high local segment mobility (most thermoplastics and thermoset plastics operate below their T_g).
c. It must be amorphous in its stable (unstressed) state for the same reason.
d. It must contain a network of cross-links to restrain gross mobility of its chains.

The process by which a network of cross-links is introduced into an elastomer is called *vulcanization*.

Up until World War II, almost all elastomers were based on natural rubber. During the war, synthetic rubbers began to replace the scarce natural rubber. Since that time production of synthetics has increased until it now far surpasses that of natural rubber. There are thousands of different elastomer compounds. Not only are there many different classes of elastomers, but also individual types can be modified with a variety of additives, fillers, and reinforcements. In addition, curing temperatures, pressures, and processing methods can be varied to produce elastomers tailored to the needs of specific applications.

There are roughly 20 major classes of elastomers. Two basic specifications provide a standard nomenclature and classification system. The ASTM standard D1418 categorizes elastomers into compositional classes. A joint ASTM-Society of Automotive Engineer (SAE) specification, ASTM 2000/SAE J200, provides a classification system based on material properties.

The nomenclature for elastomers, common names, ASTM designations, and general properties and characteristics are summarized in Appendix C. A listing of

representative tradenames, suppliers, and characteristics of specific elastomers may be found under the name of the elastomer.

See also specific elastomers by name.

electrical laminate The electrical and electronic industries use large quantities of laminated materials for primary and secondary insulations. Laminate reinforcements include paper, fabrics, and glass mats. Resins include phenolic, melamine, silicone, epoxy, and polyester. There are generally two classes of laminates used in the electrical and electronic industries: copper-clad laminates that are covered with copper foil for use in printed wiring boards and unclad laminates that are used without foil for insulation.

The National Electrical Manufacturers Association (NEMA) has organized and maintained standards on the manufacture, testing, and performance of laminated thermosetting products in the form of sheets, rods and tubes. NEMA material descriptions and the properties of NEMA-type laminates are provided in Appendix E.

The available thicknesses of laminates are a function of the type of resin binder and the thermal conductivity of the reinforcement. Cotton-based laminates can be molded up to 10 in. thick, whereas some glass-based grades are limited to 4 in.

Key physical properties are highly influenced by the reinforcing form. Paper-based laminates have a higher water absorption than do glass fabric-based grades. Phenolic resin-based grades have higher water absorption than do epoxy resin-based grades. Izod impact strengths are highest for those laminates based on glass fibers, and the same is true for flexural strengths. In most applications the dimensional stability of laminates is important. Laminates may contain considerable internal strain that can result in deformations called *warp* and *twist*.

The electrical strength of laminates is strongly affected by humidity. The electrical strength of paper-based grades decreases dramatically as humidity increases; sometimes by a factor of eight. That of the glass fiber grades also decreases, but only slightly. NEMA Laminate Grades G-5, G-7, and G-9 are used in arcing applications and all excel 180 s in the ASTM D495 arc resistance test.

electric discharge machining Electric discharge machining (EDM) is a metal working process applicable to mold construction in which controlled electrical sparking is used to erode the workpiece and form shapes.

electric insulation The term electrical insulation applies to any material that can retard the flow of electricity. Electrical insulators are used to prevent the passage or escape of electric current from conductors.

See also dielectric; dielectric properties.

electrocoating *Electrocoating is a sophisticated dipping method of coating that* was commercialized in the 1960s to solve severe corrosion problems in the automotive industry. In principle it is similar to electroplating, except that organic coatings, rather than metals, are deposited on products from an electrolytic bath.

Electrocoating can be either anodic (deposition of coatings on the anode from an alkaline bath) or cathodic (deposition of coatings on the cathode from an acidic bath). The bath is aqueous and contains very little volatile organic solvent. The phenomenon called *throwing power* causes inaccessible areas to be coated with uniform film thickness. Electrocoating is gaining a significant share of the primer and one-coat enamel coating market.

Advantages of electrocoating include environmental acceptability owing to decreased solvent emissions and increased corrosion protection to inaccessible areas. It is less labor intensive than other methods, and it produces uniform film thickness from top to bottom and inside and outside for products with a complex shape. Disadvantages are the high capital equipment costs and higher material costs, and more thorough pretreatment is required. Higher operator skills are also required.

electroformed mold An electroformed mold is a mold made by electroplating metal on the reverse pattern of the cavity. Molten steel may then be sprayed on the back of the electroformed mold to increase its strength.

electroless and electrolytic-plated plastics

See metallization of plastics; plating.

electromagnetic shielding Electromagnetic shielding (EMS) is the presence of a conductive, protective encasement around an item of electrical or electronic equipment or some of its components. Electromagnetic shielding is installed to exclude or reduce electric and/or magnetic flux within or beyond the equipment or one or more of its elements. EMS is often provided by conductive plastics.

EMS shields equipment that can produce *electromagnetic interference* (EMI) or that is affected by it (e.g., computers, television sets, telephones, etc.). Metal housings provide excellent shielding. However, conductive plastics offer lower part weight and greater facility of production. Very high conductivities have become achievable at low loading levels with some conductive metal fillers such as stainless steel fibers.

electromigration Electromigration is a detrimental effect of uncontrolled, or migrating, current on a plastic or insulating material. A common example is electromigration between conductors on a printed wiring board. This electromigration allows undesired current flow between adjacent conductors, resulting in permanent surface deposits called *dendrites* or *trees*. These deposits cause deterioration of the circuit function for which the printed wiring board has been designed.

electronic plastic Electronic plastics are defined as that group of plastic materials having certain electrical properties, which provide high performance in specific electronic product applications. This term has come into use in recent years as plastic suppliers have sought to develop and produce a wide variety of controlled-property and higher-purity plastics that better meet the requirements of high-performance and advanced electronic devices, assemblies, and systems. In addition, military and space agencies have sponsored major programs to achieve specific improvements in plastics not available in commercial plastics.

HANDBOOK OF PLASTIC MATERIALS AND TECHNOLOGY

Edited by

Irvin I. Rubin
Robinson Plastics Corporation

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87.2.2 Thermosets

Thermosets are materials that undergo a chemical cross-linking reaction when the temperature is raised. As a result, the material hardens and becomes rigid, depending on the cross-link density. When cross-linking has taken place the chemical nature of the material is irreversibly changed; thermosets cannot be reprocessed as can thermoplastics. Examples of thermosets are phenolics, polyester, epoxies, and polyurethanes.

Thermosets can be processed on screw extruders before the cross-linking reaction takes place. In these applications, good temperature control is crucial. If the stock temperature in the extruder were to exceed the kick off temperature, cross-linking could start in the extruder and the entire machine could freeze up. Therefore, extruders used to extrude thermosets are generally quite short and have low compression ratios or no compression at all.

87.2.3 Elastomers

Elastomers are polymers with rubberlike properties; in particular, the ability to undergo large elastic deformations (several hundred percent). Elastomers can be divided into thermosetting elastomers (TSE) and thermoplastic elastomers (TPE). Thermosetting elastomers are formed and then cross-linked via the application of heat and pressure, a process called vulcanization, which is a relatively slow, time-consuming process. Examples of thermosetting elastomers are natural rubber, isoprene rubber, neoprene, and nitrile rubber. Thermoplastic elastomers were first introduced in the late 1960s. They have the advantage of being able to be processed on conventional polymer processing equipment. TPEs do not require the

MASTER PROCESS OUTLINE **PROCESS** Extrusion

Instructions:
For "ALL" categories use Y = yes
For "EXCEPT FOR" categories use N = no
D = difficult

[Y] **ALL Thermoplastics**
Except for:

Acetal
Acrylonitrile–Butadiene–Styrene
Cellulosics
Chlorinated Polyethylene
Ethylene Vinyl Acetate
Ionomers
Liquid Crystal Polymers
Nylons
Poly(aryl sulfone)
Polyallomers
Poly(amid-imid)
Polyarylate
Polybutylene
Polycarbonate
Polyetherimide
Polyetherketone (PEEK)
Polyethersulfone
Poly(methyl methacrylate)
Poly(methyl pentene) (TPX)
Poly(phenyl sulfone)
Poly(phenylene ether)
Poly(phenylene oxide) (PPO)
Poly(phenylene sulfide)
Polypropylene
Polystyrene
Polysulfone
Polyurethane Thermoplastic
Poly(vinyl chloride)-PVC
Poly(vinylidine chloride)-Saran
Rubbery Styrenic Block Polymers
Styrene Maleic Anhydride
Styrene–Acrylonitrile (SAN)
Styrene–Butadiene (K Resin)
Thermoplastic Polyesters
XT Polymer

[Y] **ALL Thermosets**
Except for:

Allyl Resins
Phenolics
Polyurethane Thermoset
RP-Mat. Alkyd Polyesters
RP-Mat. Epoxy
RP-Mat. Vinyl Esters
Silicone
Urea Melamine

[Y] **ALL Fluorocarbons**
Except for:

Fluorocarbon Polymers-ETFE
Fluorocarbon Polymers-FEP
Fluorocarbon Polymers-PCTFE
Fluorocarbon Polymers-PFA
Fluorocarbon Polymers-PTFE
Fluorocarbon Polymers-PVDF

vulcanization cycle and, therefore, the mixing and compounding step can generally be eliminated. Examples of thermoplastic elastomers are styrene–butadiene copolymers, olefinic rubbers (EPR and EPDM), thermoplastic polyurethanes, and copolyesters.

Extruders used for warm feed extrusion are generally short and have deep-flighted screws to minimize temperature buildup in the material. Extruders used for cold feed extrusion are essentially the same as extruders used for thermoplastics.

87.3 EXTRUDED PRODUCTS

The number of products that can be made by the extrusion process is essentially unlimited. In its simplest form, the extruder will produce a product having a constant cross section such as pipe, sheet, or profile. These products can be flexible or rigid, depending on the polymer and the shape of the extrudate. However, by incorporating moving parts in the die or in downstream equipment, the cross section of the extruded product can be varied along the length of the extrudate. This is commonly done in extrusion blow molding where the spacing between tip and die can be varied to achieve a certain thickness profile. This technique is referred to as parison programming and is shown schematically in Figure 87.12. A similar technique is used in pipe extrusion to produce short sections having increased ID for use as fittings.

Another interesting technique is employed in the manufacture of corrugated tubing. A conveyor with the external shape of the corrugated tubing machined in its metal blocks is placed right up against the die. A positive internal air pressure forces the plastic up against the corrugated internal surface of the conveyor elements. The conveyor in this application acts as a calibrator with moving walls (Fig. 87.13).

Netting is another product that can be made by an extrusion process in which sections of the die can move. Here, the die has at least one movable section with a large number of grooves in it. The movable section rotates as it oscillates along another die section with grooves. As polymer melt flows out of the grooves, netting will be produced by the relative movement of the die sections.

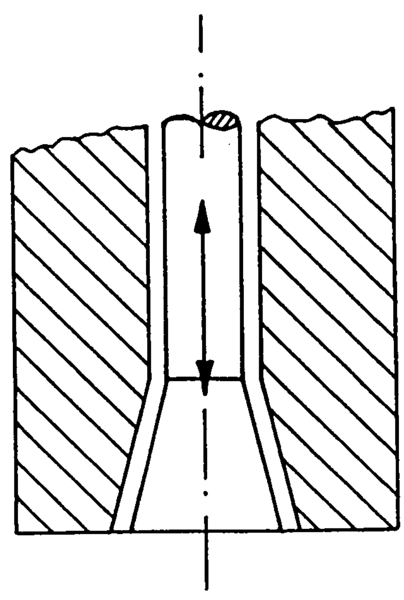

Figure 87.12. Parison programming by moving tapered tip.

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